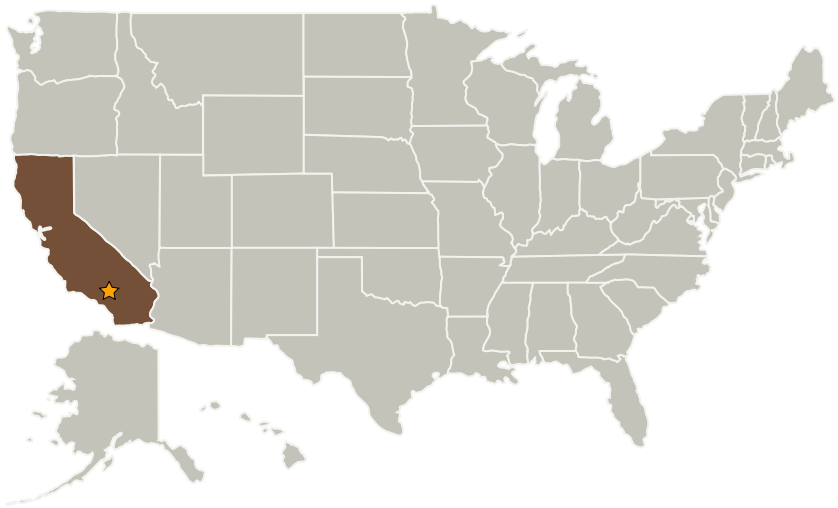
A Reusable, Oxidizer-Cooled, Hybrid Aerospike Rocket Motor for Flight Test, Phase II

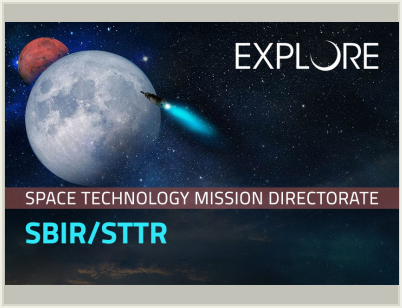
Completed Technology Project (2009 - 2011)

Project Introduction

The proposed innovation is to use the refrigerant capabilities of nitrous oxide (N2O) to provide the cooling required for reusable operation of an aerospike nozzle in conjunction with an N2O-HTPB (hydroxyl-terminated polybutadiene, a synthetic rubber that is used as a binder in solid rocket motors and as a fuel in hybrid rocket motors) hybrid rocket motor. The phase change cooling as liquid N2O is flashed into a vapor is crucial to limiting to acceptable levels the erosion of both the nozzle throat and spike, thereby enabling reusable operation and/or long burn times. The N2O used for cooling the nozzle throat will be reintroduced into the combustion chamber, and the N2O used for cooling the spike will be used to provide base bleed, virtually eliminating any performance penalty associated with using a severely truncated, and therefore significantly lighter, spike. Because of its high vapor pressure, N2O can be self-pumping, thereby making it an ideal choice of oxidizer for simple, low-cost applications. As a simple, practical nozzle, the proposed innovation fits well with N2O-HTPB hybrid rocket designs, which tend toward simpler, less expensive design alternatives. Because of their high efficiency due to altitude compensation, aerospike nozzles could play an important role in bringing to fruition inexpensive access to low Earth orbit. The simple, low-cost, reusable, oxidizer-cooled aerospike nozzle for operation on an N2O-HTPB hybrid rocket motor that is proposed will enable much-needed flight research of aerospike nozzles. These oxidizer-cooled altitude-compensating nozzles promise significant improvements in propulsion efficiency for a wide range of space vehicles and tactical missiles.

Primary U.S. Work Locations and Key Partners





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Organizational Responsibility

Responsible Mission Directorate:

Space Technology Mission Directorate (STMD)

Lead Center / Facility:

Armstrong Flight Research Center (AFRC)

Responsible Program:

Small Business Innovation Research/Small Business Tech Transfer

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Organizations Performing Work	Role	Type	Location
★Armstrong Flight Research Center(AFRC)	Lead Organization	NASA Center	Edwards, California
Rolling Hills Research Corporation	Supporting Organization	Industry	El Segundo, California

Primary U.S. Work Locations
California

Project Transitions

October 2009: Project Start

April 2011: Closed out

Project Management

Program Director:

Jason L Kessler

Program Manager:

Carlos Torrez

Technology Areas

Primary:

- TX01 Propulsion Systems
  - TX01.1 Chemical Space Propulsion
    - TX01.1.5 Hybrids